

# Hybrid Power Systems

E. Ian Baring-Gould, NREL

## San Juanico, Mexico

- Remote fishing community of 400 people with tourism in the Baja, California, region of Mexico
- Funded by Arizona Public Service, U.S. Agency for International Development, Comisión Nacional de Energía, Bergey Windpower Company, and the government of Mexico
- Power system includes:
  - 17 kW photovoltaics (PV)
  - 70 kW wind
  - 80-kW diesel generator
  - 100-kW power converter/controller
  - Advanced monitoring system
- Operational since March 1999



San Juanico wind/PV/diesel hybrid power system in Baja, California

Several hybrid power systems like this wind/solar system on site at NREL allow the study of hybrid power systems and architecture, and also provide a platform for training and demonstration of hybrid system technology.

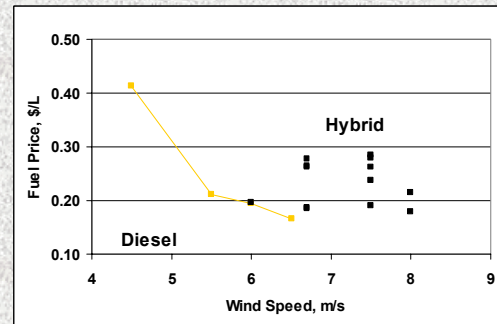


## Hybrid Power System Testing and Research

- Hybrid Power Test Bed: advanced facility to test system configurations, control, and components, including an advanced data acquisition system, 4 diesel engines, load simulators, 3 battery banks, and connections to real or simulated wind turbines
- Applications projects: installation or technical assistance in the world wide application of advanced hybrid systems
- Modeling software: development of tools to help design and analyze hybrid power systems: HOMER, Hybrid2, ViPOR, and the RPMsim system dynamics model.
- Small-system testing: testing of village-scale power systems and components

## Analytical Results

- Four areas determine the use and price of hybrid power systems in differing applications:
  - Loads that are to be served and their spatial layout
  - Renewable resources available at the location
  - Price of delivered fuel to the proposed location
  - Cost of the different electrification alternatives
- Power produced in rural areas for a price of \$0.12 to \$1.00/kWh
- Size can range from small individual home systems to large multi-megawatt diesel/wind hybrid power systems
- Computer-based modeling tools can assist in system design



Analytic break point for large hybrid power systems on remote islands in the Philippines determined through modeling

## Status

- Renewables-based hybrid power systems can help supply energy to rural applications in a clean, inexpensive way that does not burden the national economy.
- Hybrid power systems have many “nontraditional” uses such as water pumping, general rural electrification, and electrification for single homes.
- Configuration depends on many factors that must be analyzed to determine the most cost-effective solution.
- Social issues dominate over technical issues.
- Hybrid systems must be treated as power systems. Sustainable maintenance infrastructure must be considered.